BioOne COMPLETE

INDICES FOR PHYSIOLOGICAL ASSESSMENT OF NUTRITIONAL CONDITION IN PREGNANT COLLARED PECCARIES (TAYASSU TAJACU)

Authors: Lochmiller, Robert L., Hellgren, Eric C., Varnery, Larry W., and Grant, William E.

Source: Journal of Wildlife Diseases, 24(3) : 496-506

Published By: Wildlife Disease Association

URL: https://doi.org/10.7589/0090-3558-24.3.496

BioOne Complete (complete.BioOne.org) is a full-text database of 200 subscribed and open-access titles in the biological, ecological, and environmental sciences published by nonprofit societies, associations, museums, institutions, and presses.

Your use of this PDF, the BioOne Complete website, and all posted and associated content indicates your acceptance of BioOne's Terms of Use, available at www.bioone.org/terms-of-use.

Usage of BioOne Complete content is strictly limited to personal, educational, and non - commercial use. Commercial inquiries or rights and permissions requests should be directed to the individual publisher as copyright holder.

BioOne sees sustainable scholarly publishing as an inherently collaborative enterprise connecting authors, nonprofit publishers, academic institutions, research libraries, and research funders in the common goal of maximizing access to critical research.

Downloaded From: https://complete.bioone.org/journals/Journal-of-Wildlife-Diseases on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

Journal of Wildlife Diseases, 24(3), 1988, pp. 496–506
© Wildlife Disease Association 1988

INDICES FOR PHYSIOLOGICAL ASSESSMENT OF NUTRITIONAL CONDITION IN PREGNANT COLLARED PECCARIES (*TAYASSU TAJACU*)

Robert L. Lochmiller,[1,2] Eric C. Hellgren,[1] Larry W. Varner,[3] and William E. Grant[1]

[1] Department of Wildlife and Fisheries Sciences, Texas A&M University, College Station, Texas 77843, USA
[2] Present address: Department of Zoology, Oklahoma State University, Stillwater, Oklahoma 74078, USA
[3] Agricultural Research and Extension Center, Texas A&M University, Uvalde, Texas 78801, USA

ABSTRACT: Hematological and serum biochemical responses to two levels of dietary energy (high energy [HE], 3300 kcal digestible energy [DE]/kg; moderate energy [ME], 2300 kcal DE/kg) and protein (high protein [HP], 16.0% crude protein; moderate protein [MP], 8.4% crude protein) during gestation in 15 collared peccaries (*Tayassu tajacu*) were examined. Dietary energy and protein levels influenced body weight gain during gestation. Red blood cell counts and lymphocyte concentrations were higher and neutrophil concentrations were lower among females fed an HP diet compared to those fed an MP diet. Alkaline phosphatase and alpha-2 globulin concentrations were higher among females fed an MP diet. Aspartate aminotransferase and cholesterol concentrations were higher and calcium and thyroxine concentrations were lower among females fed ME diets compared to those fed HE diets. These results suggest that physiological indices used in combination with morphological measurements can be useful in assessing collared peccary nutritional health during gestation.

Key words: Collared peccary, *Tayassu tajacu*, gestation, hematology, nutrition, physiology, serum chemistry, physiological condition, experimental study.

INTRODUCTION

Drought-induced nutritional stress is common among collared peccaries (*Tayassu tajacu*) inhabiting arid environments of southwestern United States. A strong relationship exists between rainfall and reproductive success of peccaries in Texas (Low, 1970; Bissonette, 1982) and Arizona (Sowls and Maurer, 1985). Assessment of animal condition during the breeding season can be useful for predicting reproductive success, juvenile survival, disease resistance and herd recruitment. Because dietary demands are elevated during gestation and lactation (Gallagher, 1981), metabolic adaptations to nutritional deficiencies may be more evident in reproductive than in nonreproductive animals.

Only a few tested methodologies for assessing collared peccary condition currently are available. Body weight has been suggested as a possible index to condition (Sowls and Maurer, 1985), but such morphometric measures provide insufficient diagnostic information for determining marginal or specific nutrient deficiencies. Hematological and serum biochemical constituents may provide more sensitive alternatives for assessing condition of peccaries. Previous research has indicated that metabolic blood profiles can be useful in assessing nutritional status of nonreproductive female (Lochmiller et al., 1985b) and male (Lochmiller et al., 1985a) collared peccaries. The objective of this study was to examine effects of dietary energy and protein during gestation on hematological, metabolic and hormonal constituents of blood in pregnant collared peccaries from southern Texas.

MATERIALS AND METHODS

Wild-caught adult female collared peccaries from southern Texas (22°57′N, 99°51′W) were housed in an outdoor enclosure for ≥8 mo and fed a commercial pelleted ration for swine (16.0% crude protein; Purina Mills, St. Louis, Missouri 63164, USA) ad libitum prior to the start of this experiment. Sixteen females were mated to captive adult males, assigned to one

Downloaded From: https://complete.bioone.org/journals/Journal-of-Wildlife-Diseases on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

of four dietary groups, paired, and housed in 3- × 2-m pens. A known quantity of feed was given in excess daily to females receiving the high energy–high protein (HEHP) diet and the uneaten portion remaining after each day was reweighed. The other three diet groups were provided with a quantity of feed equal to the previous day's consumption of HEHP ration. The diets were pelleted and supplied in a factorial design with two levels of energy (high energy [HE], 3300 kcal digestible energy [DE]/kg; moderate energy [ME], 2300 kcal DE/kcal) and protein (high protein [HP], 16.0% crude protein; moderate protein [MP], 8.4% crude protein). The essential mineral and vitamin components of each diet were formulated using National Research Council (1979) recommendations for swine (*Sus scrofa*). A complete description of experimental diets was described previously (Lochmiller et al., 1987). One female (HEMP) died at day 54 of gestation and was deleted from all analyses.

Blood samples and morphologic measurements were obtained from animals between 0700 and 1000 hr every 28 days (7 Mar to 30 May 1983) until just prior to parturition. Sampling order was determined randomly for each of the four periods sampled. Peccaries were immobilized with ketamine hydrochloride (Ketaset, Bristol Laboratories, Syracuse, New York 13201, USA) at a dosage of 20 mg/kg administered intramuscularly in the hindlimb. Blood samples were taken from the anterior vena cava using vacuum tube assemblies (Lochmiller et al., 1984). Blood was collected from each female using a 7-ml tube containing sodium EDTA for hematology and four 10-ml tubes for serum. Blood was allowed to clot and placed on ice. Coagulated blood was centrifuged for 20 min at 2,000 *g* and 2 C, and serum was stored at −20 C until assayed.

Hematological determinations were performed within 4 hr after collection. Red blood cell count (RBC), hematocrit (HCT), hemoglobin concentration (Hb), mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC) and mean corpuscular hemoglobin (MCH) were determined as described by Lochmiller et al. (1985c). Total plasma protein and fibrinogen concentrations were determined using the method of Low et al. (1967). Serum samples were analyzed as a batch on a Technicon SMAC biocohemical analyzer (Technicon Instruments Corp., Tarrytown, New York 10591, USA) for concentrations of total protein, urea nitrogen (BUN), creatinine, total bilirubin, cholesterol, glucose, triglycerides, uric acid, alkaline phosphatase (ALP), gamma glutamyl transferase (GGT), aspartate aminotransferase (AST), alanine aminotransferase (ALT), lactate dehydrogenase (LD), calcium, sodium, chloride, phosphorus, and potassium following the methods of Lochmiller and Grant (1984). Nonesterified fatty acids (NEFA) were determined enzymatically using a kit provided by Wako Chemicals USA, Inc. (Dallas, Texas 75234, USA). Serum proteins were separated by agarose gel electrophoresis using the procedure described by Miyake et al. (1977). Relative concentrations of albumin, and alpha-1, alpha-2, beta-1, beta-2, and gamma globulins were determined with a Ultrascan Laser densitometer (LKB Instruments, Inc., Gaithersburg, Maryland 20877, USA). Absolute concentrations of protein fractions were determined by multiplying relative concentration by total protein concentration. Concentrations of magnesium, iron, copper and zinc were determined by atomic absorption spectrophotometry (Varian Techtron Model AA-6; Varian, Sunnyvale, California 94089, USA) using the procedures described by Fernandez and Kahn (1971). Thyroxine (T_4) and triodothyronine (T_3) were assayed using kits provided by Nuclear-Medical Laboratories (Irving, Texas 75061, USA). T_4- and T_3-antibody cross-reactivates with T_3 and T_4, respectively, were 2.0 and 0.4%, respectively. Linearity of T_4 and T_3 dose response curves of kits was demonstrated by addition of known quantities of hormone. Intraassay variability was 3.0% for both constituents.

The analysis of variance procedure (P2V) for repeated measures in the Biomedical Computer Programs System (BMDP) was used to assess effects of dietary energy (high, moderate), dietary protein (high, moderate), and duration (28-day, 56-day, 84-day, 112-day sample) of treatment on pregnant female blood constituents (Jennrich et al., 1983). Sources of variation in the statistical model were partitioned and tested as described by Hellgren et al. (1985). Statistical significance was determined at $P \leq 0.05$ and the use of the terms significant or significantly refer to statistical significance.

RESULTS AND DISCUSSION

Body weight

Dietary energy and protein levels significantly affected body weight gain. Pregnant females receiving the HEHP diet gained ($\bar{x} \pm$ SE) 2.7 ± 0.05 kg of body weight over the 112-day trial. Females on the other three diets lost weight (MEMP, −0.04 ± 0.4 kg) or gained <0.4 ± 0.5 kg (MEHP) body weight (HEMP, 0.3 ± 0.8 kg).

Downloaded From: https://complete.bioone.org/journals/Journal-of-Wildlife-Diseases on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

TABLE 1. Hematological characteristics and concentrations of serum chemistries of pregnant collared peccaries not influenced by dietary protein, energy, or sample date.

Assay	Mean ± standard error
Mean corpuscular hemoglobin concentration (g%)	34.60 ± 0.2
White blood cell count (cells × 10^3/mm^3)	11.50 ± 0.4
Basophils (%)	1.40 ± 0.1
Total plasma protein (g/dl)	7.40 ± 0.1
Uric acid (mg/dl)	0.29 ± 0.03
Total bilirubin (mg/dl)	0.11 ± 0.01
Gamma glutamyl transferase (IU/liter)	10.10 ± 0.5
Sodium (mmol/liter)	147.90 ± 0.2
Chloride (mmol/liter)	110.30 ± 0.4
Potassium (mmol/liter)	3.78 ± 0.05
Magnesium (mg/dl)	1.82 ± 0.02
Copper (μg/dl)	297.00 ± 4
Albumin (g/dl)	3.31 ± 0.02
Alpha-1 globulin (g/dl)	0.54 ± 0.01
Beta-2 globulin (g/dl)	0.42 ± 0.01
Gamma globulin (g/dl)	2.11 ± 0.07

Hematology

Mean corpuscular hemoglobin concentration, WBC, and percent basophils remained stable throughout gestation (Table 1). Hematocrit, Hb, MCH, MCV, fibrinogen, percent eosinophils, and percent monocytes fluctuated significantly during gestation (Table 2), but were not influenced significantly by dietary energy or protein. Only RBC, neutrophil, and lymphocyte concentrations showed a significant relationship to diet composition (Fig. 1). Females fed HP diets had higher RBC counts than those on MP diets. Protein intake is known to alter erythropoesis in cases of malnutrition (Harper, 1971). Nonpregnant female peccaries receiving a 55% ad libitum diet for 84 days experienced a 23% reduction in RBC (Lochmiller et al., 1985b). Red blood cell count has been suggested as a useful index of condition for wild peccaries in southern Texas (Lochmiller et al., 1985c).

There was considerable variation in white cell populations among individuals. Although total WBC showed no relation-

TABLE 2. Mean (± SE) values of hematological characteristics and concentrations of serum chemistries of pregnant collared peccaries which differed significantly with sample day, but were not influenced by dietary protein or energy.

Assay	Sample day of experiment			
	28	56	84	112
Hematocrit (%)	41.3 ± 0.7	40.5 ± 1.0	40.9 ± 1.1	37.3 ± 0.9
Hemoglobin (g/dl)	14.3 ± 0.3	14.1 ± 0.3	13.9 ± 0.3	12.9 ± 0.3
Mean corpuscular hemoglobin (pg)	19.5 ± 0.2	20.3 ± 0.3	19.7 ± 0.2	19.9 ± 0.2
Mean corpuscular volume (fl)	56.2 ± 0.5	58.0 ± 0.9	57.8 ± 0.7	57.2 ± 0.5
Fibrinogen (mg/dl)	240.0 ± 21.0	207.0 ± 22.0	260.0 ± 21.0	340.0 ± 29.0
Eosinophils (%)	2.8 ± 0.6	2.0 ± 0.6	2.8 ± 0.6	4.9 ± 0.9
Monocytes (%)	1.7 ± 0.4	2.4 ± 0.4	1.1 ± 0.3	1.1 ± 0.4
Creatinine (mg/dl)	1.3 ± 0.1	1.4 ± 0.1	1.6 ± 0.1	1.8 ± 0.1
Total serum protein (g/dl)	7.1 ± 0.1	7.3 ± 0.1	7.4 ± 0.2	7.2 ± 0.1
Triglycerides (mg/dl)	16.1 ± 3.6	10.9 ± 2.3	19.6 ± 4.2	23.8 ± 3.7
Glucose (mg/dl)	112.0 ± 2.0	102.0 ± 3.0	101.0 ± 2.0	99.0 ± 3.0
Lactate dehydrogenase (IU/liter)	1,095.0 ± 121.0	1,150.0 ± 158.0	1,226.0 ± 155.0	1,322.0 ± 162.0
Phosphorus (mg/dl)	4.3 ± 0.1	4.4 ± 0.1	4.8 ± 0.2	5.1 ± 0.2
Iron (μg/dl)	228.0 ± 10.0	214.0 ± 13.0	202.0 ± 10.0	178.0 ± 11.0
Zinc (μg/dl)	66.0 ± 2.0	67.0 ± 2.0	64.0 ± 1.0	58.0 ± 2.0
Total beta globulin (g/dl)	1.1 ± 0.1	1.1 ± 0.4	1.0 ± 0.1	1.0 ± 0.1

Downloaded From: https://complete.bioone.org/journals/Journal-of-Wildlife-Diseases on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

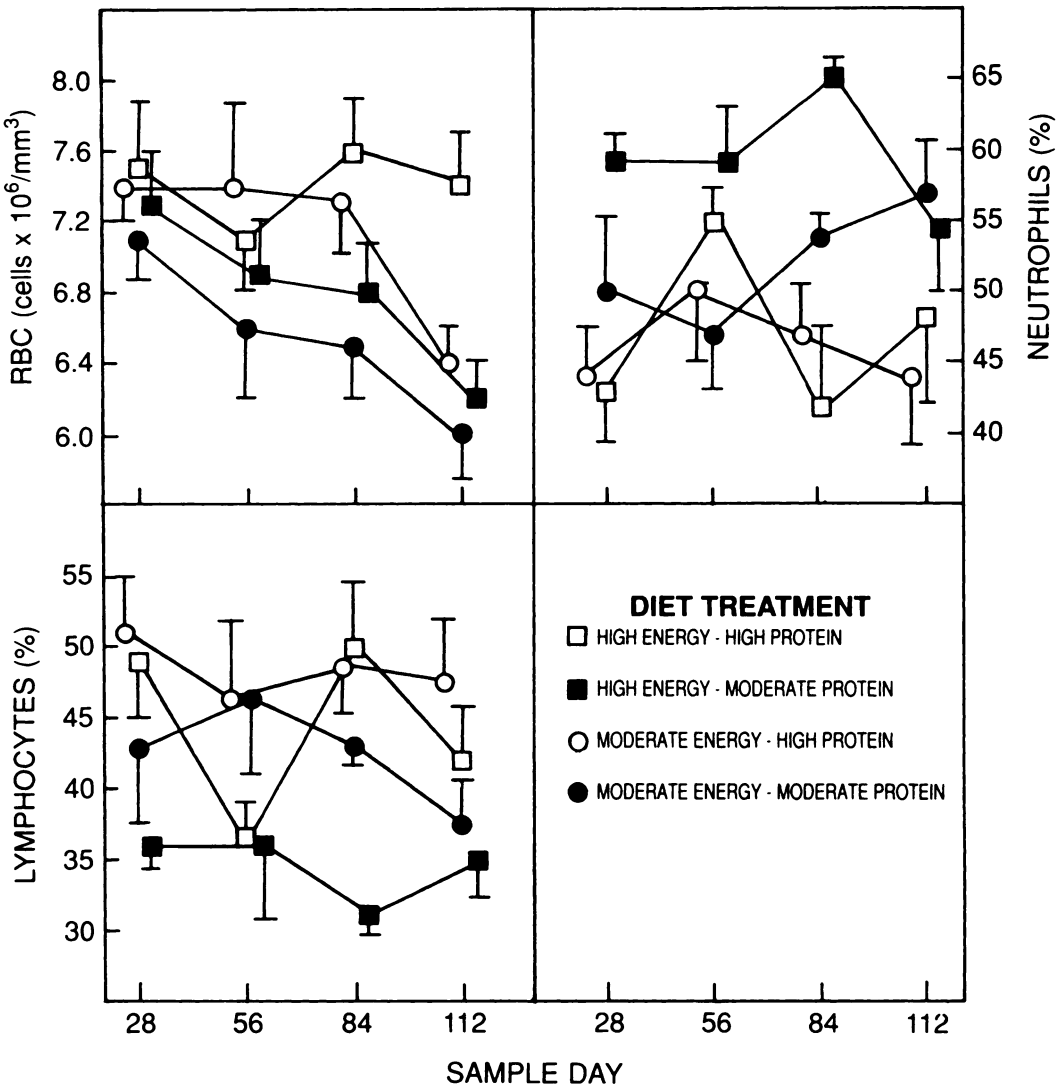


FIGURE 1. Mean (± SE) values of hematological characteristics of pregnant collared peccaries influenced significantly ($P < 0.05$) by dietary protein.

ship to diet, differential counts revealed lower lymphocyte and higher neutrophil concentrations in MP groups. Changes in the white cell counts are common during malnutrition (Chandra et al., 1982). Changes in certain hormones such as thyroxine, cortisol, and thymic hormone during malnutrition have been implicated in altering the white blood cell population (Chandra, 1979; Suskind, 1982). Bubenik and Brownlee (1987) showed WBC indices to be useful for assessing health of male white-tailed deer (*Odocoileus virginianus*).

Serum nonprotein nitrogen

Urea nitrogen concentration and urea: creatinine ratio offered a sensitive index to protein intake in pregnant peccaries (Table 3). Urea nitrogen concentration was significantly greater among females fed HP diets in comparison to those fed MP diets. There was also a significant energy–protein interaction, reflecting an elevation in

Downloaded From: https://complete.bioone.org/journals/Journal-of-Wildlife-Diseases on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

TABLE 3. Mean (± SE) concentrations of selected serum chemistries in pregnant collared peccaries influenced by dietary protein or energy.

Sample day	Diet[a]	Urea nitrogen[b,c] (mg/dl)	Urea nitrogen: creatinine[b,c,d] (ratio)	Cholesterol[c,d] (mg/dl)	Nonesterified fatty acids[b] (meq/liter)	Calcium[c,e] (mg/dl)	Thyroxine[c,e] (μg/dl)
28	HEHP	10.2 ± 1.9	7.3 ± 1.2	94 ± 9	0.44 ± 0.07	9.9 ± 0.4	4.7 ± 0.6
	HEMP	8.3 ± 0.3	6.2 ± 0.1	106 ± 10	0.15 ± 0.05	10.2 ± 0.1	5.2 ± 1.1
	MEHP	15.2 ± 1.9	12.4 ± 0.9	93 ± 7	0.36 ± 0.10	10.0 ± 0.2	4.0 ± 0.3
	MEMP	4.2 ± 0.2	3.1 ± 0.3	86 ± 4	0.10 ± 0.07	9.6 ± 0.2	4.6 ± 0.9
56	HEHP	9.2 ± 0.8	6.4 ± 0.3	87 ± 2	0.27 ± 0.03	10.0 ± 0.1	3.9 ± 0.2
	HEMP	3.7 ± 0.9	2.7 ± 0.8	100 ± 11	0.16 ± 0.04	10.1 ± 0.2	4.0 ± 0.2
	MEHP	9.5 ± 2.2	6.3 ± 1.0	93 ± 7	0.33 ± 0.03	9.4 ± 0.2	4.0 ± 0.2
	MEMP	3.0 ± 0.6	2.0 ± 0.3	82 ± 7	0.14 ± 0.03	9.6 ± 0.2	3.1 ± 0.3
84	HEHP	8.5 ± 1.2	6.0 ± 1.0	94 ± 5	0.11 ± 0.04	10.0 ± 0.1	4.1 ± 0.5
	HEMP	3.7 ± 0.9	2.4 ± 0.6	122 ± 15	0.24 ± 0.07	9.6 ± 0.1	3.8 ± 0.2
	MEHP	12.5 ± 1.4	7.8 ± 0.2	100 ± 4	0.42 ± 0.13	9.6 ± 0.2	3.2 ± 0.1
	MEMP	4.5 ± 0.6	2.6 ± 0.3	92 ± 5	0.26 ± 0.02	9.5 ± 0.1	3.4 ± 0.4
112	HEHP	8.2 ± 1.2	5.6 ± 1.0	100 ± 8	0.27 ± 0.15	10.1 ± 0.1	4.3 ± 0.5
	HEMP	5.3 ± 0.7	3.0 ± 0.3	119 ± 12	0.26 ± 0.01	9.4 ± 0.2	4.6 ± 0.6
	MEHP	13.8 ± 2.4	7.0 ± 0.6	103 ± 5	0.49 ± 0.13	9.1 ± 0.2	3.4 ± 0.6
	MEMP	5.5 ± 0.3	3.0 ± 0.1	91 ± 4	0.22 ± 0.10	9.2 ± 0.2	4.1 ± 0.5

[a] HEHP (high energy–high protein), HEMP (high energy–moderate protein), MEHP (moderate energy–high protein), MEMP (moderate energy–moderate protein).
[b] $P < 0.05$—high protein versus moderate protein.
[c] $P < 0.05$—sample day effect.
[d] $P < 0.05$—energy × protein interaction.
[e] $P < 0.05$—high energy versus moderate energy.

BUN concentration within ME diet groups. The inverse relationship between BUN and dietary energy at low levels of intake has been attributed to protein tissue catabolism (Kirkpatrick et al., 1975). Although peccaries on ME intakes had stable body weights during gestation, the use of dietary amino acids and protein reserves for energy could have accounted for the slight elevation of BUN in these diet groups.

Serum creatinine concentration did not differ with respect to diet as expected (Woo et al., 1979); however, there was a significant increase throughout gestation (Table 2). Uric acid concentration remained stable throughout gestation (Table 1).

Serum lipids

Concentrations of cholesterol (Table 3) and triglycerides (Table 2) differed significantly during gestation. The mean concentration of cholesterol increased from 94 ± 4 mg/dl (28-day sample) to 102 ± 4 mg/dl (112-day sample). Triglyceride concentration followed a pattern similar to cholesterol (Table 2).

Serum cholesterol and NEFA concentrations appear to be useful indices for assessing condition of pregnant peccaries (Table 3). Highest concentrations of cholesterol were associated with diets moderate in energy or protein and high in the other diet component, as indicated by a significant energy–protein interaction. Nonpregnant peccaries fed restricted diets typically show depressed cholesterol concentrations (Lochmiller et al., 1985b). Surprisingly, NEFA concentration was significantly higher for pregnant females fed a HP diet. As adipose tissue is mobilized to supply metabolic needs for energy, NEFA levels characteristically increase in an animal (Bowden, 1971). In swine, NEFA concentrations normally increase during pregnancy (Ruiz et al., 1972). Atinmo et al. (1974) noted that protein-restricted pregnant swine had lower levels of NEFA than controls on energy-restricted swine

Downloaded From: https://complete.bioone.org/journals/Journal-of-Wildlife-Diseases on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

during gestation. Lebeda and Prikrylova (1981) demonstrated that the diet energy: protein ratio can have a profound influence on serum NEFA of cattle. They noted significantly higher NEFA concentrations in cows fed low-energy–high-protein diets compared to cows fed diets higher in energy and lower in protein.

Serum enzymes

Lactate dehydrogenase was the only enzyme of the five measured that varied significantly with sample date during gestation (Table 2). Lactate dehydrogenase showed a 20% increase in concentration from the 28-day to 112-day sample. Gamma glutamyl transferase concentration remained stable throughout gestation (Table 1).

Alkaline phosphatase, AST and ALT concentrations were influenced by diet composition (Fig. 2). Concentration of ALP was significantly higher among females fed MP diets compared to females fed HP diets. Pregnant females fed ME diets had significantly higher concentrations of AST than those fed a HE diet. Alanine aminotransferase concentration also was related to diet as indicated by a significant energy–protein interaction. Females fed diets moderate in energy or protein and high in the other diet component had elevated ALT concentrations compared to other diet groups.

Serum enzymes are often useful indices for differentiating sources of cellular lysis or dysfunction (bone, skeletal muscle, liver). Elevated ALP can signify a change in osteoblastic or osteoclastic activity (Cornelius, 1970); however, the source of ALP could not be determined with certainty in this study. Alkaline phosphatase has been shown to increase dramatically in male peccaries fed a restricted diet for 3 wk (Lochmiller et al., 1985a). Since AST activity is present in a variety of tissues, the source of increase in females fed ME diets is difficult to assess (Cornelius, 1970). It is doubtful that differential handling trauma contributed to the energy effect since all animals were handled identically. A slight increase in proteolytic activity in muscle tissue of energy restricted females might have been a contributing factor (Lochmiller et al., 1985b) even though the nutritional deficit was moderate. Alanine amino transferase determination is usually applied in the diagnosis of hepatocellular lesions (Zimmerman, 1979). Although ALT concentration appeared to be related to the energy–protein ratio of the diet, ALT concentrations were not high enough to suggest extensive liver dysfunction. Alanine amino transferase concentration is not a sensitive index to energy status in pregnant swine (Ruiz et al., 1972).

Serum minerals

Electrolyte concentrations showed no relationship to dietary energy or protein, and remained stable throughout gestation (Table 1). Likewise, concentrations of magnesium and copper remained unchanged during gestation (Table 1). Calcium (Table 3), phosphorus, iron, and zinc (Table 2) showed significant sample variation during gestation. Phosphorus concentrations increased, whereas, calcium, iron, and zinc concentrations decreased from the 28-day to 112-day sample. The mineral changes observed in pregnant peccaries are similar to those occurring in swine (Tumbleson et al., 1970; Nachreiner and Ginter, 1972) and women (Dawson et al., 1969) during gestation.

Serum calcium concentration was the only mineral constituent measured that showed a relationship to diet (Table 3). Pregnant females fed ME diets had significantly lower calcium concentrations than those fed HE diets. Depressed serum calcium concentrations have also been reported in nonreproductive peccaries fed restricted diets (Lochmiller et al., 1986).

Serum proteins

Nutritional inadequacies that alter liver function in protein synthesis often result in alterations of circulating serum proteins.

Downloaded From: https://complete.bioone.org/journals/Journal-of-Wildlife-Diseases on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

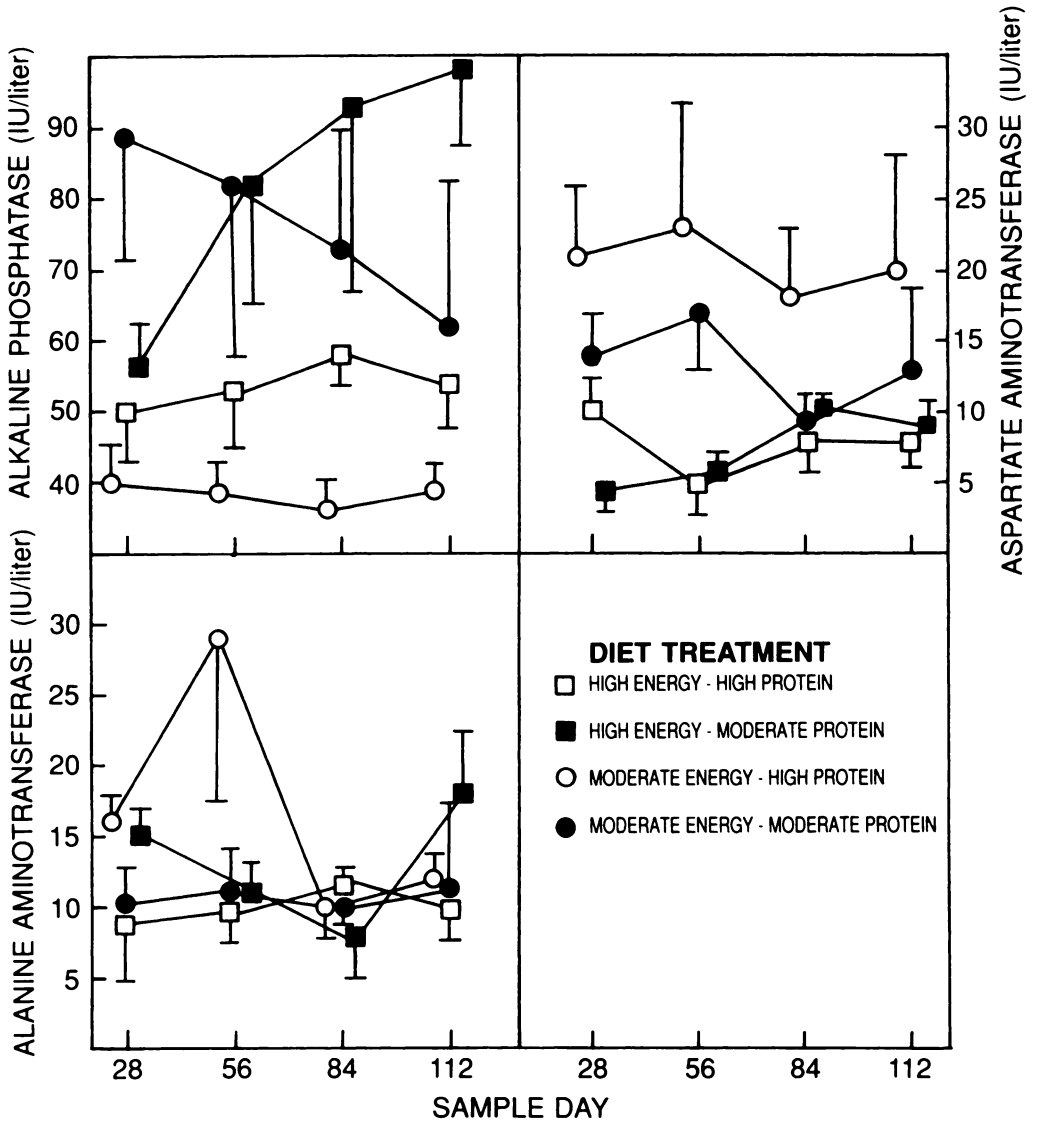


FIGURE 2. Mean (± SE) concentrations of serum enzymes in pregnant collared peccaries influenced significantly ($P < 0.05$) by dietary protein (alkaline phosphatase), energy (aspartate aminotransferase), or the energy × protein interaction (alanine aminotransferase).

Traditionally, albumin has been the protein considered most useful for assessing protein status in swine (Atinmo et al., 1974). Recently, the diagnostic value of other protein fractions such as transferrin, beta-lipoprotein and prealbumin for assessing protein status have been demonstrated (Yen et al., 1982).

In this study, albumin, alpha-1 globulin, beta-2 globulin and gamma globulin concentrations remained unchanged throughout gestation (Table 1). Total serum protein and total beta globulin concentration varied significantly during gestation (Table 2). Total serum protein concentration was highest for the 84-day sample, but total beta globulin concentration decreased steadily throughout gestation. Although pregnant swine fed restricted protein diets show reductions in total serum protein (Rippel et al., 1965), this index is probably not sensitive enough to be valu-

Downloaded From: https://complete.bioone.org/journals/Journal-of-Wildlife-Diseases on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

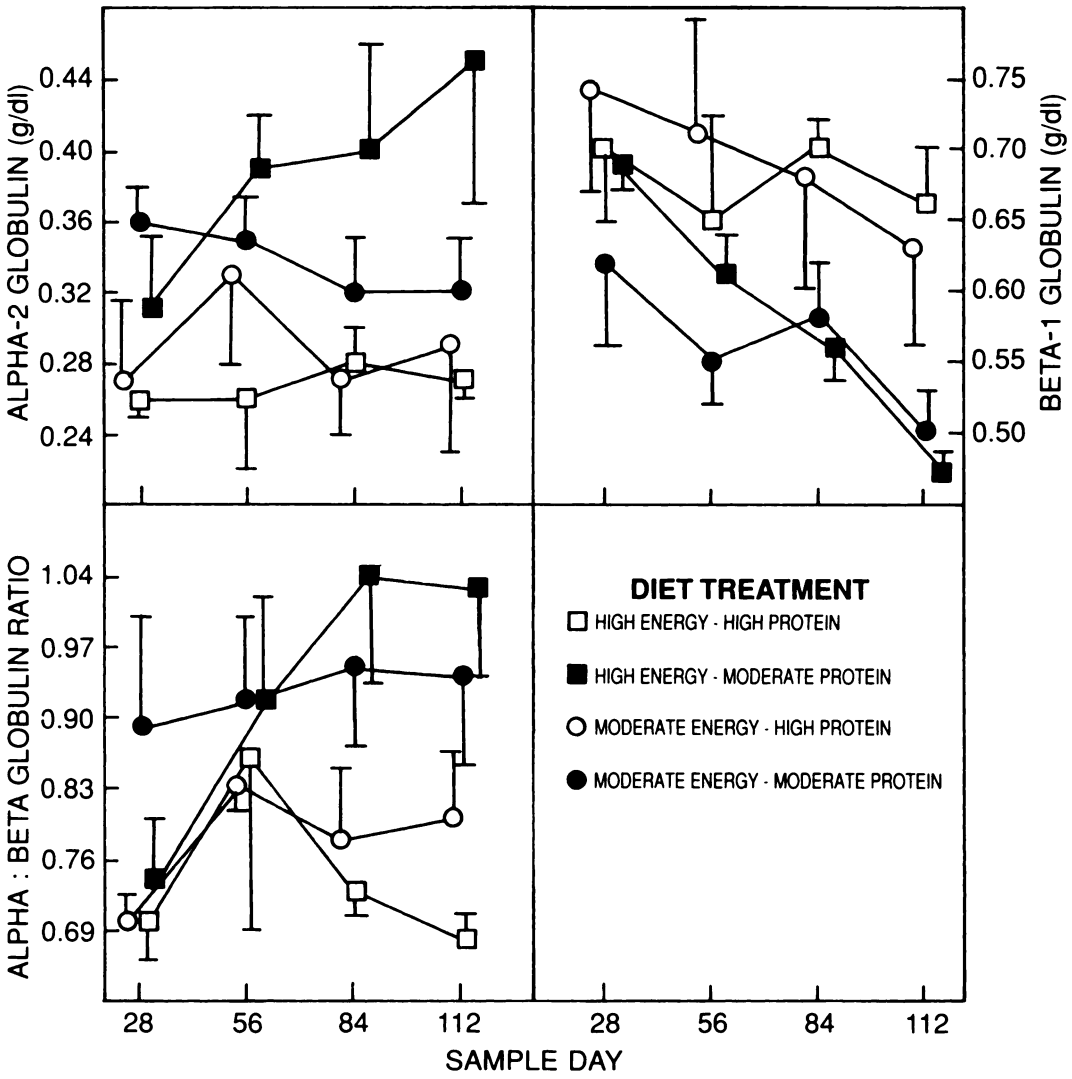


FIGURE 3. Mean (± SE) concentrations of serum proteins in pregnant collared peccaries influenced significantly ($P < 0.05$) by dietary protein.

able in diagnosing protein malnutrition in pregnant peccaries.

Alpha-2 globulin, beta-1 globulin, and the alpha globulin : beta globulin ratio were significantly influenced by diet protein concentration (Fig. 3). Pregnant females fed MP diets had higher concentrations of alpha-2 globulin compared to HP fed females. In comparison to other diet groups, females on the HEHP diet showed little sample variation in alpha-2 globulin concentration during gestation. Elevated concentrations of alpha globulins during periods of malnutrition have been reported for pregnant swine (Rippel et al., 1965) and peccaries (Lochmiller et al., 1986). Alpha globulins were unaffected by stage of gestation. This should enhance its usefulness as an index of protein status in pregnant peccaries.

Beta-1 globulin concentrations were consistently higher among females fed HP diets compared to those fed a MP diet. Transferrin is the major component of beta-1 globulin fraction, while lipoproteins contribute to both beta-1 and beta-2 frac-

Downloaded From: https://complete.bioone.org/journals/Journal-of-Wildlife-Diseases on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

tions (Ritchie, 1979). Decreased transferrin synthesis (Yen et al., 1982) probably was responsible for lower beta-1 globulin concentrations among pregnant peccaries fed a MP diet. Alpha globulin: beta globulin ratio reflected both alpha and beta globulin responses to dietary protein, indicating that this index is more sensitive than separate measures of alpha and beta globulin concentration in the pregnant peccary.

Thyroid status

Normal thyroid function is considered essential for optimal reproduction in swine (Benjaminsen, 1981). Thyroxine concentrations were significantly lower in peccaries fed a ME diet compared to those fed a high energy diet during gestation (Table 3). Atinmo et al. (1978) found a significant impairment of thyroid function in protein-restricted swine during gestation. Similarly, nonpregnant female peccaries fed restricted diets, show depressed thyroxine concentrations (Lochmiller et al., 1985b). Decreases in circulating thyroxine during malnutrition has been attributed to decreased production of thyroxine binding globulin (Ingenbleek and Malvaux, 1980).

Concluding remarks

Assessment of general nutritional health and condition in the pregnant collared peccary could enhance management of this species. This study reveals a variety of metabolic and hormonal indices which can be useful for assessing protein–energy status during gestation. In particular, concentrations of RBC, BUN, ALP, and the alpha globulin: beta globulin ratio were very sensitive to protein intake while thyroxine provided a good index of energy intake. Dietary differences in blood indices were most prominent during the latter stages of gestation, probably due to the depletion of body reserves and elevated demands for fetal growth. We suggest using a combination of blood indices with morphologic measurements, such as body weight and fat indices, to assess condition of pregnant collared peccaries. This approach will improve diagnostic capabilities when compared with using a single index of condition.

ACKNOWLEDGMENTS

This research was supported financially by the Caesar Kleberg Research Program in Wildlife and Fisheries Sciences, Texas A&M University and the National Rifle Association of America. We gratefully acknowledge the assistance of the Chaparrosa Ranch and staff, the Chaparral Wildlife Management Area and staff and the Texas A&M University Swine Research Center.

LITERATURE CITED

ATINMO, T., C. BOLDIJAO, W. G. POND, AND R. H. BARNES. 1978. The effect of dietary protein restriction on serum thyroxine levels of pregnant or growing swine. Journal of Nutrition 108: 1456–1533.

———, W. G. POND, AND R. H. BARNES. 1974. Effect of dietary energy vs. protein restriction on blood constituents and reproductive performance in swine. Journal of Nutrition 104: 1033–1040.

BENJAMINSEN, E. 1981. Plasma thyroxine in the sow during pregnancy and lactation and during resumption of ovarian activity after weaning. Acta Veterinaria Scandinavica 22: 1–13.

BISSONETTE, J. A. 1982. Ecology and social behavior of the collared peccary in Big Bend National Park, Texas. U.S. National Park Service Scientific Monograph Series No. 16, Washington, D.C., 85 pp.

BOWDEN, D. M. 1971. Non-esterified fatty acids and ketone bodies in blood as indicators of nutritional status in ruminants. Canadian Journal of Animal Science 51: 1–13.

BUBENIK, G. A., AND L. BROWNLEE. 1987. Assessing health of male white-tailed deer by white blood cell counts. The Journal of Wildlife Management 51: 57–58.

CHANDRA, R. K. 1979. Serum thymic hormone activity in protein-energy malnutrition. Clinical and Experimental Immunology 38: 228–230.

———, S. SAHNI, AND S. CHANDRA. 1982. Cellular and humoral immunity in malnutrition. *In* Marker proteins in inflammation, R. C. Allen, J. Bienvenu, P. Laurent, and R. M. Suskind (eds.). Walter de Gruyter, New York, New York, pp. 347–353.

CORNELIUS, C. E. 1970. Liver function. *In* Clinical biochemistry of domestic animals, J. J. Kaneko and C. E. Cornelius (eds.). Academic Press, New York, New York, pp. 161–230.

DAWSON, E. B, R. R. CLARK, AND W. J. MCGANITY.

Downloaded From: https://complete.bioone.org/journals/Journal-of-Wildlife-Diseases on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

1969. Plasma vitamins and trace metal changes during teen-age pregnancy. American Journal of Obstetrics and Gynecology 104: 953–958.

FERNANDEZ, F. J., AND H. L. KAHN. 1971. Clinical methods for atomic absorption spectroscopy. Clinical Chemical Newsletter 3: 24–28.

GALLAGHER, J. F. 1981. Diet, nutrition and forage requirements of javelina in south Texas. M.S. Thesis. Texas A&M University, College Station, Texas, 85 pp.

HARPER, H. A. 1971. Review of physiological chemistry. Lange Medical Publishers, Los Altos, California, 529 pp.

HELLGREN, E. L., R. L. LOCHMILLER, M. S. AMOSS, AND W. E. GRANT. 1985. Serum progesterone, estradiol-17B, and glucocorticoids in the collared peccary during gestation and lactation as influenced by dietary protein and energy. General and Comparative Endocrinology 59: 358–368.

INGENBLEEK, Y., AND P. MALVAUX. 1980. Peripheral turnover of thyroxine and related parameters in infant protein-calorie malnutrition. American Journal of Clinical Nutrition 33: 609–616.

JENNRICH, R., P. SAMPSON, AND J. FRANE. 1983. Analysis of variance and covariance including repeated measures. *In* BMPD statistical software, W. J. Dixon (ed.). University of California Press, Los Angeles, California, pp. 359–387.

KIRKPATRICK, R. L., P. E. BUCKLAND, W. A. ABLER, P. F. SCANLON, J. B. WHELAN, AND H. C. BURKHART. 1975. Energy and protein influences on blood urea nitrogen of white-tailed deer fawns. The Journal of Wildlife Management 39: 692–698.

LEBEDA, M., AND J. PRIKRYLOVA. 1981. Influence of energy-yielding nutrients in summer and winter feed rations on the levels of non-esterified fatty acids in the blood plasma of cows in various lactation phases. Acta Veterinaria Brno 50: 179–189.

LOCHMILLER, R. L., AND W. E. GRANT. 1984. Serum chemistry of the collared peccary (*Tayassu tajacu*). Journal of Wildlife Diseases 20: 134–140.

———, E. C. HELLGREN, AND W. E. GRANT. 1987. Influence of moderate nutritional stress during gestation on reproduction of collared peccaries (*Tayassu tajacu*). Journal of Zoology (London) 211: 321–328.

———, ———, R. M. ROBINSON, AND W. E. GRANT. 1984. Techniques for collecting blood from collared peccaries *Dicotyles tajacu* (L.). Journal of Wildlife Diseases 20: 47–50.

———, ———, L. W. VARNER, AND W. E. GRANT. 1986. Serum and urine biochemical indicators of nutritional status in adult female collared peccaries, *Tayassu tajacu* (Tayassuidae). Comparative Biochemistry and Physiology 83A: 477–488.

———, ———, ———, L. W. GREENE, M. S. AMOSS, S. W. SEAGER, AND W. E. GRANT. 1985a. Physiological responses of the adult male collared peccary, *Tayassu tajacu* (Tayassuidae), to severe dietary restriction. Comparative Biochemistry and Physiology 82A: 59–65.

———, L. W. VARNER, AND W. E. GRANT. 1985b. Metabolic and hormonal responses to dietary restriction in adult female collared peccaries. The Journal of Wildlife Management 49: 733–741.

———, ———, AND ———. 1985c. Hematology of the collared peccary. The Journal of Wildlife Management 49: 65–71.

LOW, E. M., H. B. HILL, AND R. L. SEARCY. 1967. Simple method for detection of abnormal plasma fibrinogen levels. American Journal of Clinical Pathology 47: 538.

LOW, W. A. 1970. The influence of aridity on reproduction of the collared peccary (*Dicotyles tajacu* (Linn.) in Texas. Ph.D. Thesis. University of British Columbia, Vancouver, Canada, 170 pp.

MIYAKE, J., H. FEHRNSTROM, AND B. WALLENBORG. 1977. Agarose gel electrophoresis with LKB 2117 Multiphor. LKB-Produkter AB, Broma, Sweden, Application Note 310: 1–5.

NACHREINER, R F., AND O. J. GINTER. 1972. Gestational and periparturient periods of sows: Serum chemical and hematologic changes during gestation. American Journal of Veterinary Research 33: 2215–2219.

NATIONAL RESEARCH COUNCIL. 1979. Nutrient requirements of swine. National Academy of Sciences, Washington, D.C., 52 pp.

RIPPEL, R. H., B. G. HARMON, A. H. JENSEN, H. W. NORTON, AND D. E. BECKER. 1965. Response of the gravid gilt to levels of protein as determined by nitrogen balance. Journal of Animal Science 24: 209–215.

RITCHIE, R. F. 1979. Specific proteins. *In* Clinical diagnosis and management by laboratory methods, J. B. Henry (ed.). W. B. Saunders Company, Philadelphia, Pennsylvania, pp. 228–258.

RUIZ, M. E., R. C. EWAN, AND V. C. SPEER. 1972. Serum metabolites of pregnant and hysterectomized gilts fed two levels of energy. Journal of Animal Science 32: 1153–1159.

SOWLS, L. K., AND D. A. MAURER. 1985. Characteristics of harvested peccaries in relation to rainfall patterns in southeastern Arizona. *In* Game harvest management, S. L. Beasom and S. F. Robertson (eds.). Caesar Kleberg Wildlife Research Institute, Kingsville, Texas, pp. 249–259.

SUSKIND, R. M. 1982. Protein-calorie malnutrition-clinical biochemical immunological. *In* Marker proteins in inflammation, R. C. Allen, J. Bienvenu, P. Laurent, and R. M. Suskind (eds.). Walter de Gruyter, New York, New York, pp. 277–339.

TUMBLESON, M. E., M. F. BUCKS, M. P. SPATE, D. P. HUTCHESON, AND C. C. MIDDLETON. 1970. Serum biochemical and hematological parameters of Sinclair (S-1) miniature sows during gestation

Downloaded From: https://complete.bioone.org/journals/Journal-of-Wildlife-Diseases on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use

and lactation. Canadian Journal of Comparative Medicine 34: 312–319.

WOO, J., J. J. TREUTING, AND D. C. CANNON. 1979. Metabolic intermediates and inorganic ions. *In* Clinical diagnosis and management by laboratory methods, J. B. Henry (ed.). W. B. Saunders, Philadelphia, Pennsylvania, pp. 259–304.

YEN, J. T., W. G. POND, AND R. T. STONE. 1982. Serum transferrin and albumin in protein-deficient young pigs. Nutrition Reports International 25: 561–566.

ZIMMERMAN, H. J. 1979. Evaluation of the function and integrity of the liver. *In* Clinical diagnosis and management by laboratory methods, J. B. Henry (ed.). W. B. Saunders Company, Philadelphia, Pennsylvania, pp. 305–346.

Received for publication 24 November 1987.

Downloaded From: https://complete.bioone.org/journals/Journal-of-Wildlife-Diseases on 29 Mar 2024
Terms of Use: https://complete.bioone.org/terms-of-use